CLAIMS

The invention being fully described, what is claimed is as follows:

1. The method of amplifying an analog signal in conversion to a digital signal so as to exploit the range of the analog to digital converter throughout the signal through dynamic gain control, comprising the following steps:
   a. First, amplifying the signal;
   b. Second, selectively amplifying segments of the carrier signal;
   c. Digitizing said signal;
   d. Adjusting amplification achieved in selectively amplifying segments of the carrier signal in a gain scaling stage such that resulting amplification of said signal segments is a power of two;
   e. Analyzing said amplified signal;
   f. Reversing said selective amplification of said signal segments selectively amplified by shifting bits in a digital representation of the signal.
2. The method of extracting a small signal modulated on an analog carrier signal in a digital circuit, comprising the following steps:
   a. In an electrical circuit, synthesizing digital sine and cosine functions;
   b. Amplifying the analog carrier signal to a maximum amplitude of an input range of an analog-to-digital converter;
   c. Selectively amplifying segments of the analog carrier signal by employing a selectable amplifier under control of a computer that selectively scales the signal in sections in optimizing respective sections of the signal to the input range of the analog-to-digital converter;

d. Digitizing said analog carrier signal into a digital carrier signal with the analog to digital converter;

e. Mixing said digital carrier signal with said digital sinusoidal functions into quadrature components;

f. Adjusting amplification achieved in selectively amplifying segments of the carrier signal in a gain scaling stage such that resulting amplification of said signal segments is a power of two, a controller directing gain adjustment after examining the size of a digital signal from the analog to digital converter in order to set the gain of the selectable amplifier, and wherein the controller sets the gain scaling value to $G_C = \frac{G_H \bullet G_L'}{G_L \bullet G_H'}$ where G_H/G_L is the desired gain ratio of the selectable amplifier, and G'_L/G'_H is the ratio of the actual low gain of the selectable amplifier to its actual high gain at the frequency of the phase accumulator.

g. Isolating the small signal by filtering said mixed digital carrier signal with a low-pass filter;

h. Reversing said amplification of said signal segments selectively amplified by the controller setting the selectable amplifier and a bit shifter to remove amplitude and phase discontinuities, the bit shifter shifting bits in a digital representation of the carrier signal, the computer calculating values of the phase offset and the gain scaling in a calibration algorithm programmed into the computer, said algorithm recognizing amplitude and phase discontinuities after the bit shifter and dictating adjustments in the gain scaling value and the phase offset value, the computer communicating the adjustments to the

controller, which communicates them to the gain scaling and phase offset stage.

3. The method of claim 2 further including the step of adjusting phase of the digital carrier signal before it is converted to analog correcting for unwanted phase changes to the carrier signal that occur in the selectable amplifier by a controller directing introduction of a phase offset, if the controller chooses a low gain because the signal is large, then including the step of the controller also setting the phase offset to zero degrees and the gain scaling value to 1.0, but if the controller sets a high gain for the selectable amplifier because the signal is small, then including the step of the controller also setting the phase offset to be equal and opposite the phase change of the selectable amplifier.